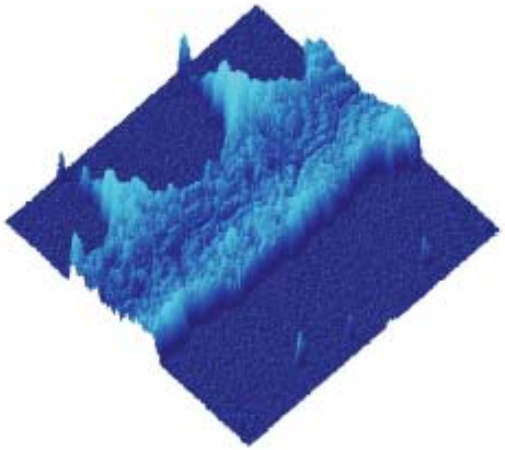
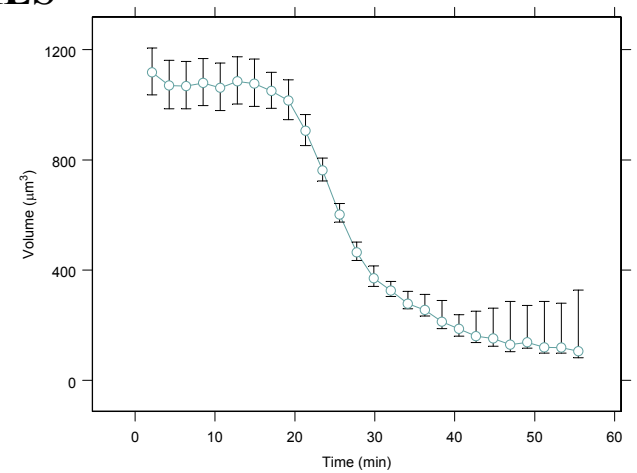
In-situ Microstructural Characterization of Polyhydroxyalkanoates (PHAs)

Brian H. Augustine, Douglas E. Dennis **DMR-0071717**

RECENT ACTIVITIES



In-situ AFM images in fluid at 23°C of μ-CP P(3HB-co-14%-3HV) thin film in 1:1 dilution of buffer and *Streptomyces spp. 5A* depolymerase. Each frame (1 s) is 7.9 min. for a total of 86.5 min.



Polymer volume (μm³) vs. biodegradation time (min) for μ-CP patterned P(3HB-co-8%-3HV) thin film at 40°C. Error bars are 99% confidence intervals.

Understanding the rate and mechanism of the degradation of surfaces is vital for many different technologies. We have developed a technique using microcontact printing (μ-CP) and the fluid scanning capability in the AFM to monitor the biodegradation of thin films of biodegradable polymers called polyhydroxyalkanoates (PHAs) both *in-situ* and in real-time in a biodegradable enzyme solution. The degradation rate calculated from this data is in qualitative agreement with the literature. This AFM technique is broadly applicable to study the degradation process in other materials, and can be used both to quantify the degradation process, and to determine the initial degradation mechanism in a variety of materials.

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UNDERGRADUATE TEACHING AND RESEARCH

JMU senior, Brian LaTuga, injecting enzyme into the scanning AFM to measure the biodegradation of PHA thin films patterned by microcontact printing.

A total of thirteen undergraduate students, one high school student, three secondary school science teachers [one middle school, one high school, and one pre-service (now teaching high school in Northern Virginia)], and a professor at a small PUI have been directly supported on this project since the start of this work. Three of the students are currently attending graduate school (Cornell in microbiology, Cornell and the University of Virginia in chemistry). Eight are still undergraduate students with four planning on attending graduate school who have not completed their studies. All of the students and teachers have worked in conjunction with many other undergraduate research students funded through our NSF-REU sites in chemistry and materials science at JMU. All were participants in the activities associated with the REU sites such as visits to Dominion Semiconductor in Manassas, VA, the National Institutes of Standards and the Naval Research Labs. They also presented their work at the REU symposia at the termination of their summer projects. In addition, work from the past four summers has resulted in 28 presentations (15 oral / 13 posters, including 5 invited presentations) at regional (11) or national meetings (14) and departmental seminars (4). Six publications have resulted with 15 undergraduate authors, one middle school teacher and a paper to be submitted with another high school teacher as co-author.